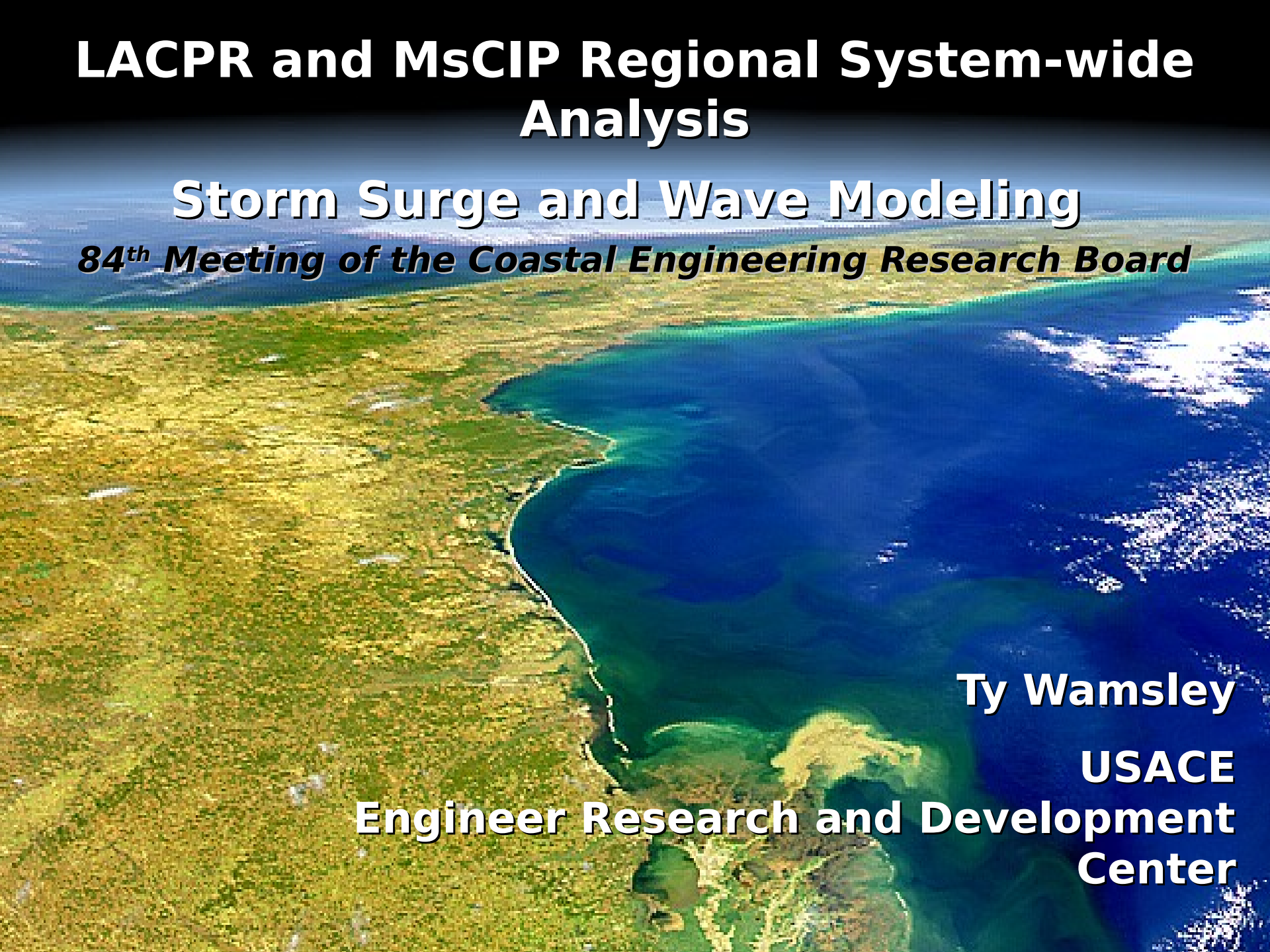
LACPR and MsCIP Regional System-wide Analysis

Storm Surge and Wave Modeling

84th Meeting of the Coastal Engineering Research Board



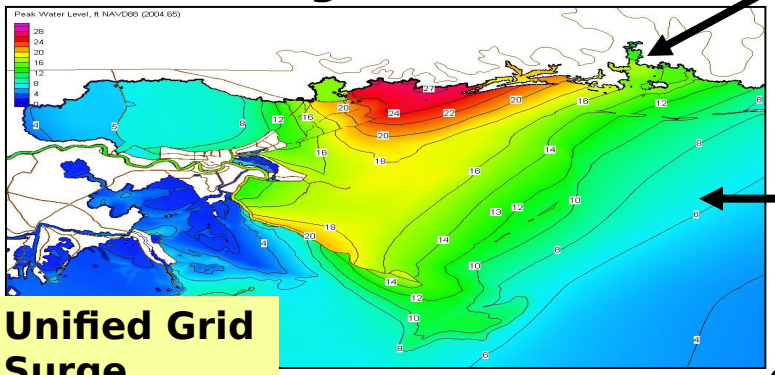
Ty Wamsley

USACE Engineer Research and Development Center

Modeling System

- IPET
- FEMA
- LaCPR
- MsCIP

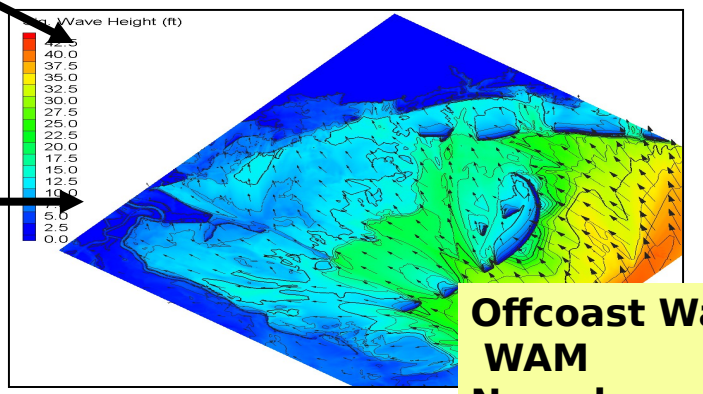
Surge Model



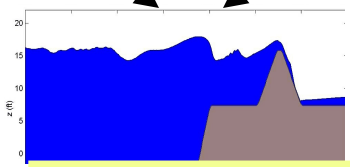
Unified Grid Surge model: ADCIRC

Coupling

Wave Models

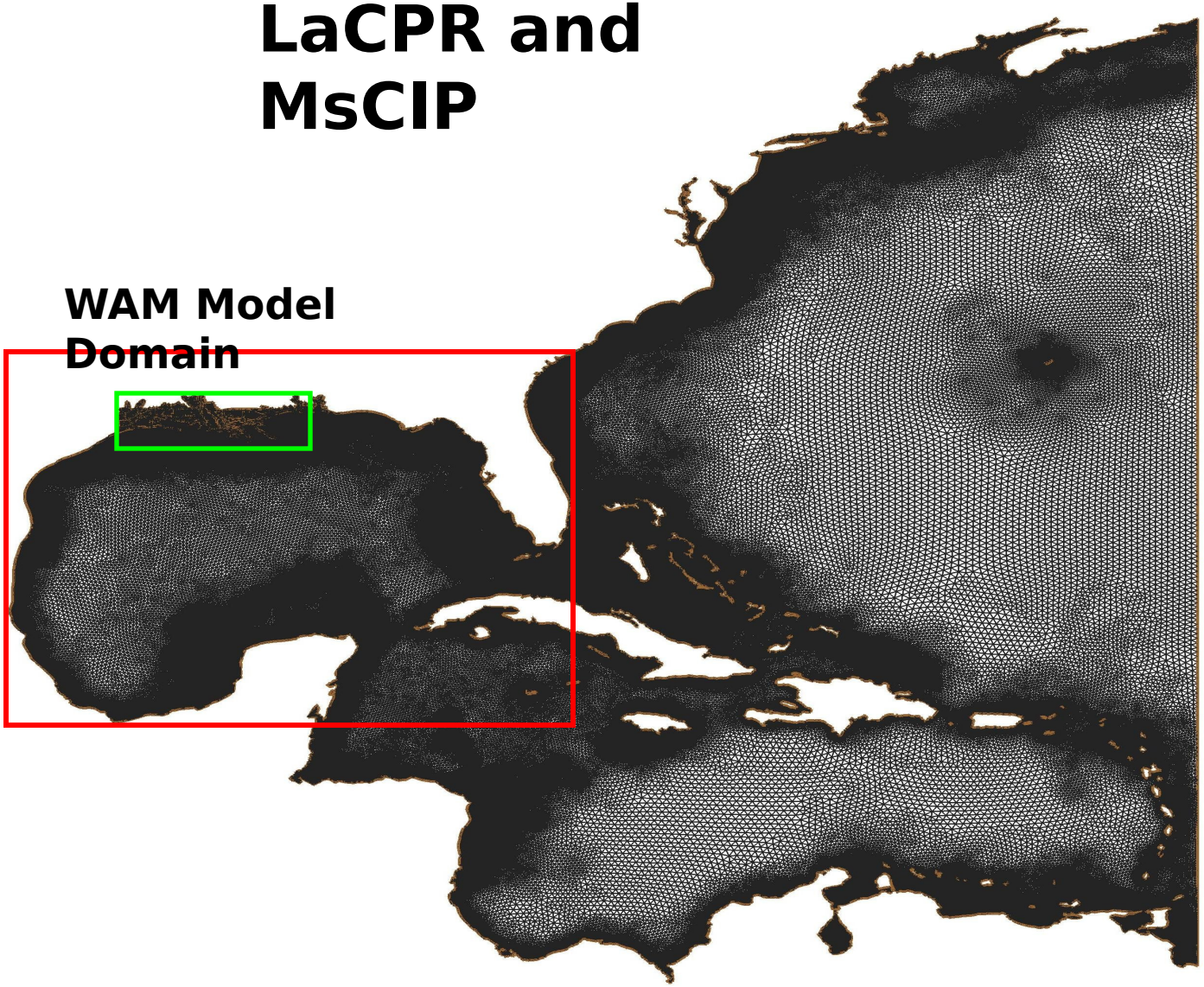


Offcoast Waves: WAM
Nearshore Waves: STWAVE

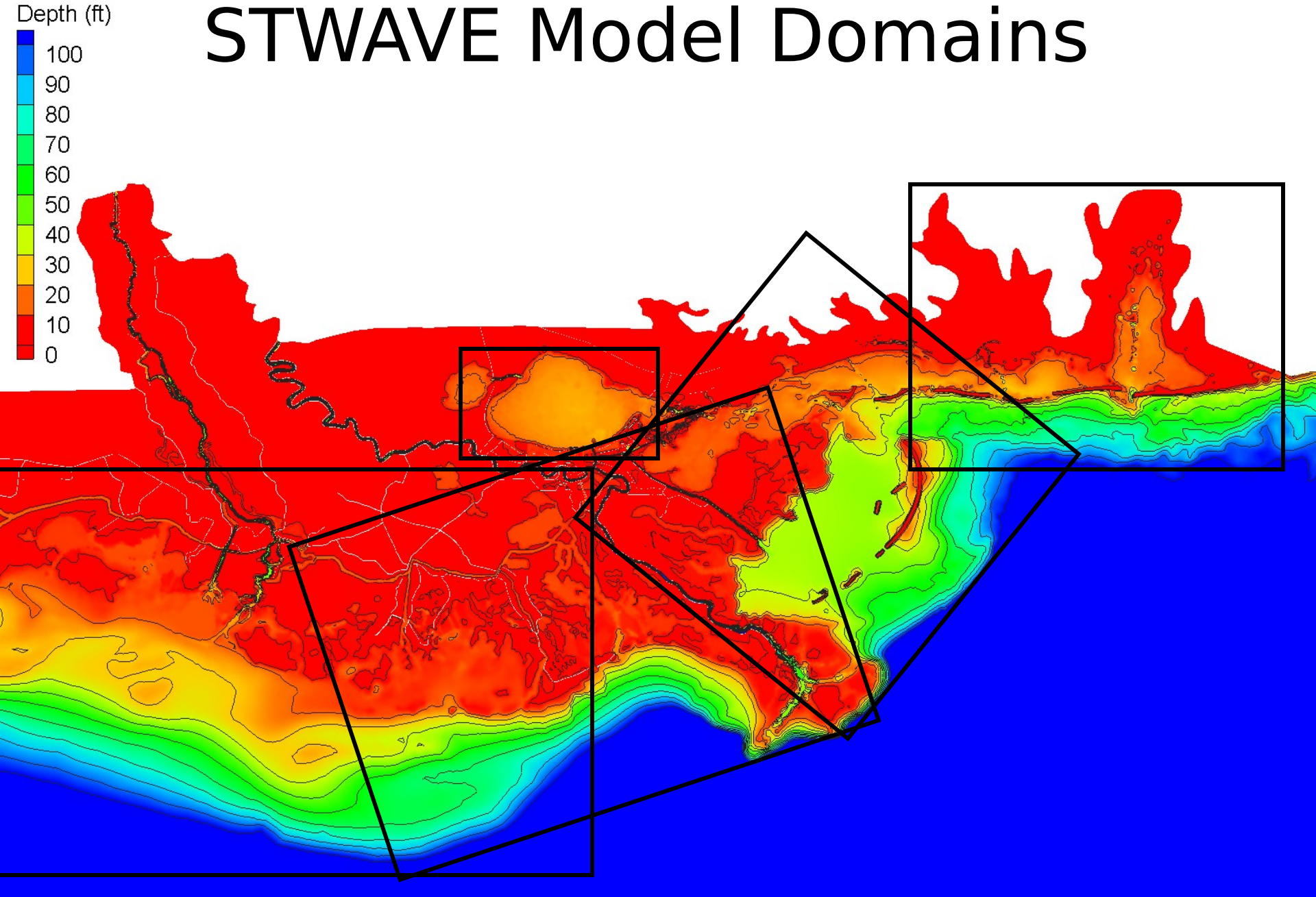


Local Scale Waves: Boussinesq - Parametric

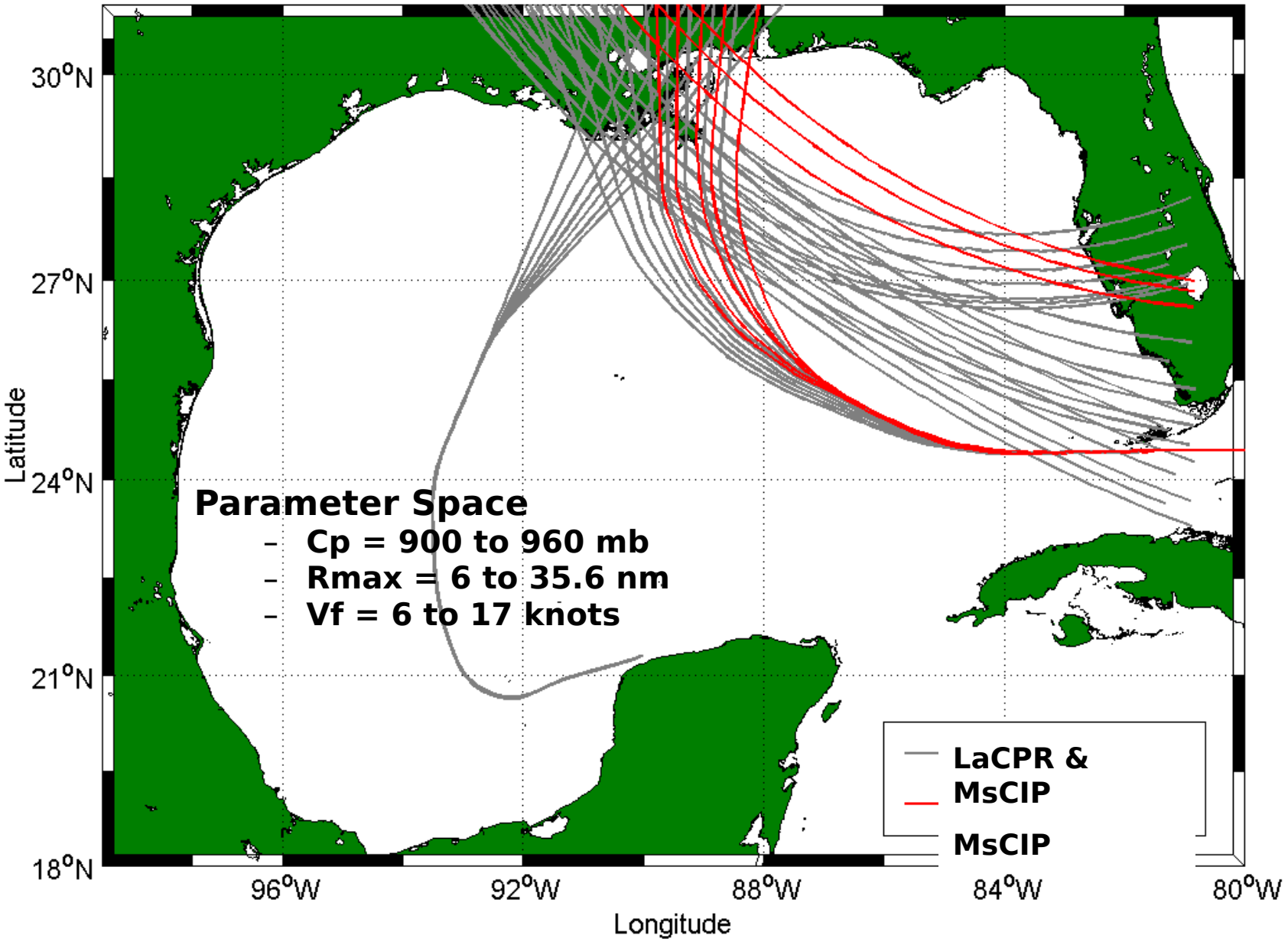
ADCIRC Grid Domain



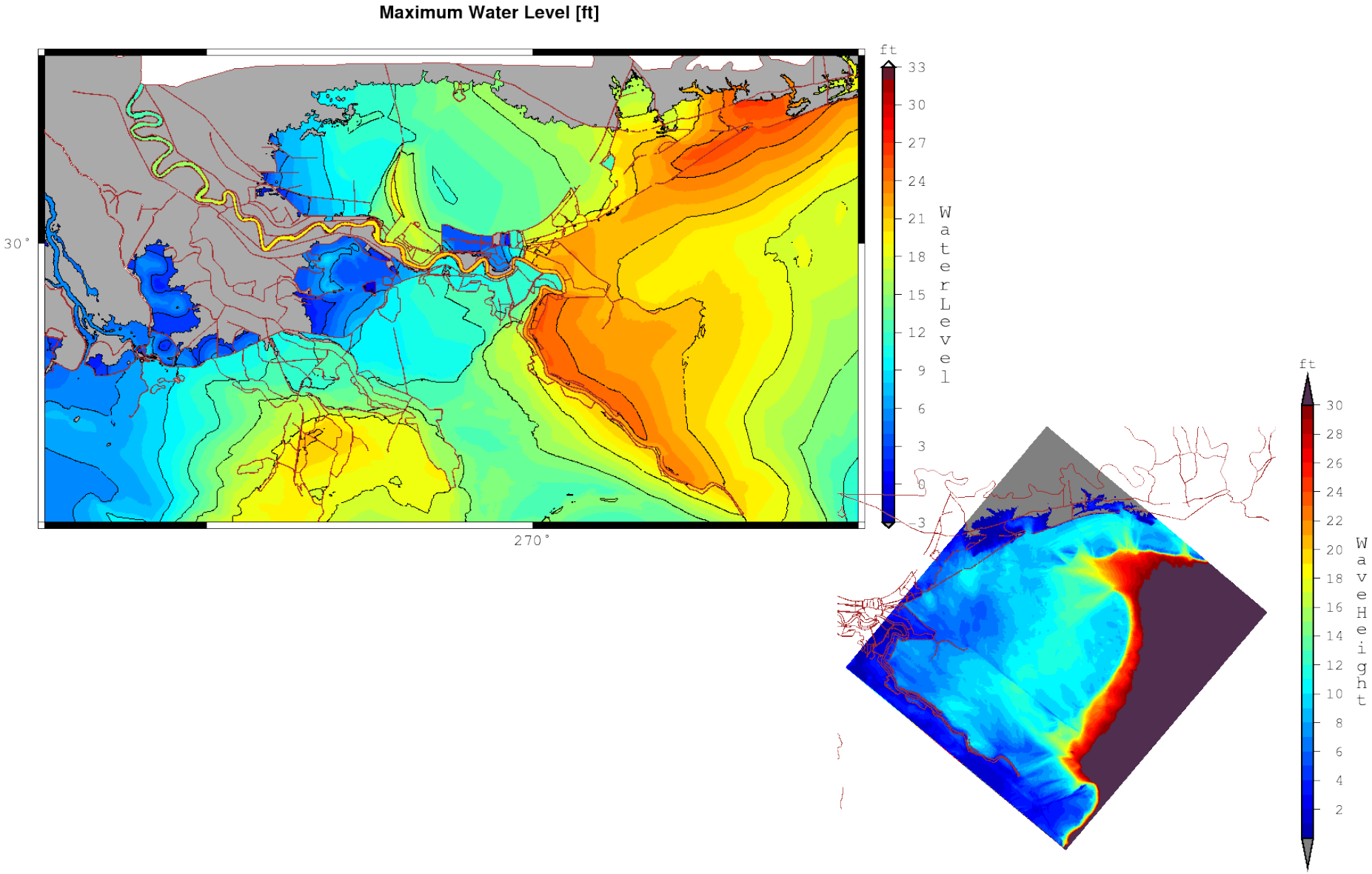
STWAVE Model Domains

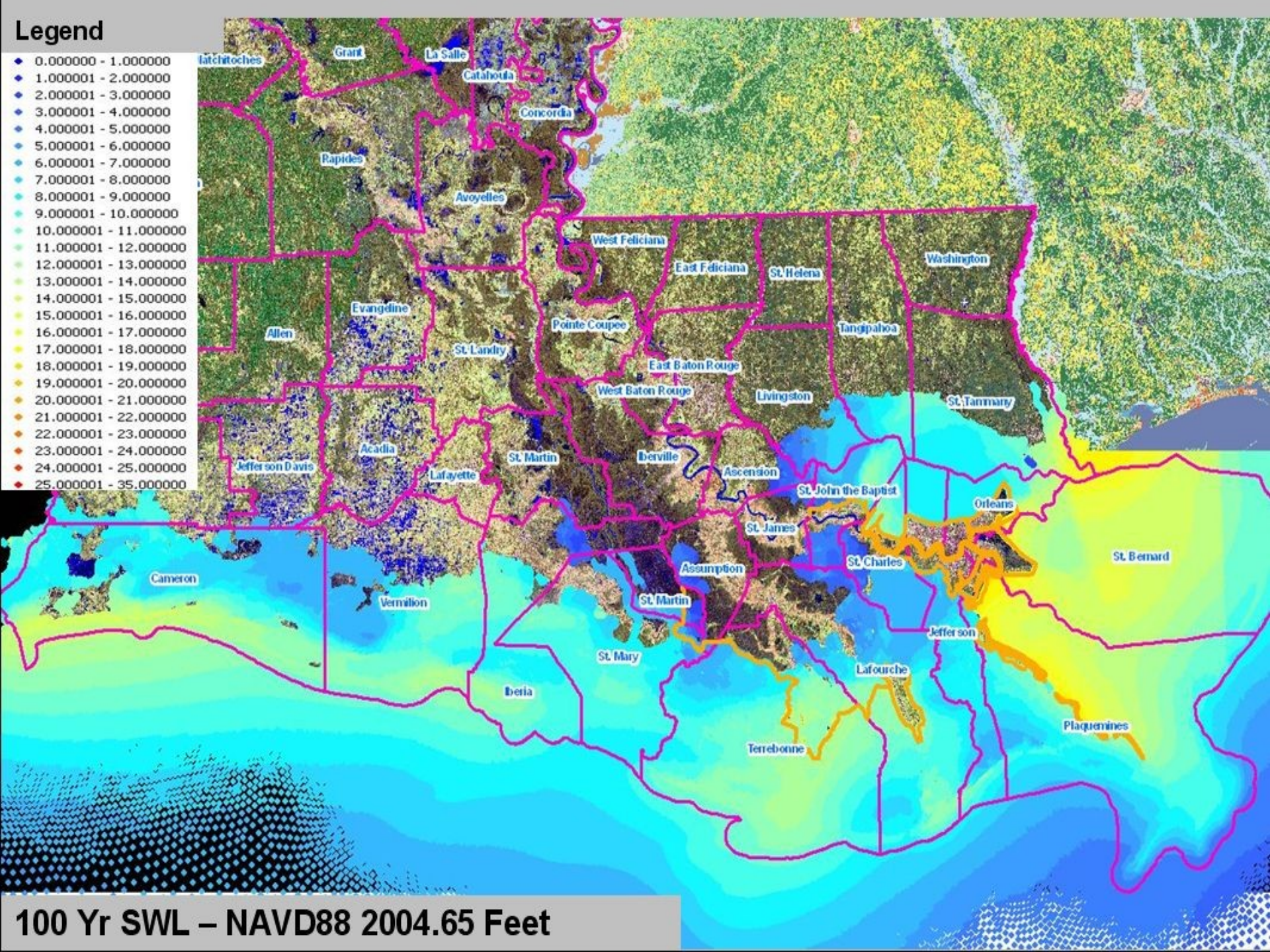


Storms for JPM-OS



Peak Surge and Waves

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2.000001 - 3.000000
3.000001 - 4.000000
4.000001 - 5.000000
5.000001 - 6.000000
6.000001 - 7.000000
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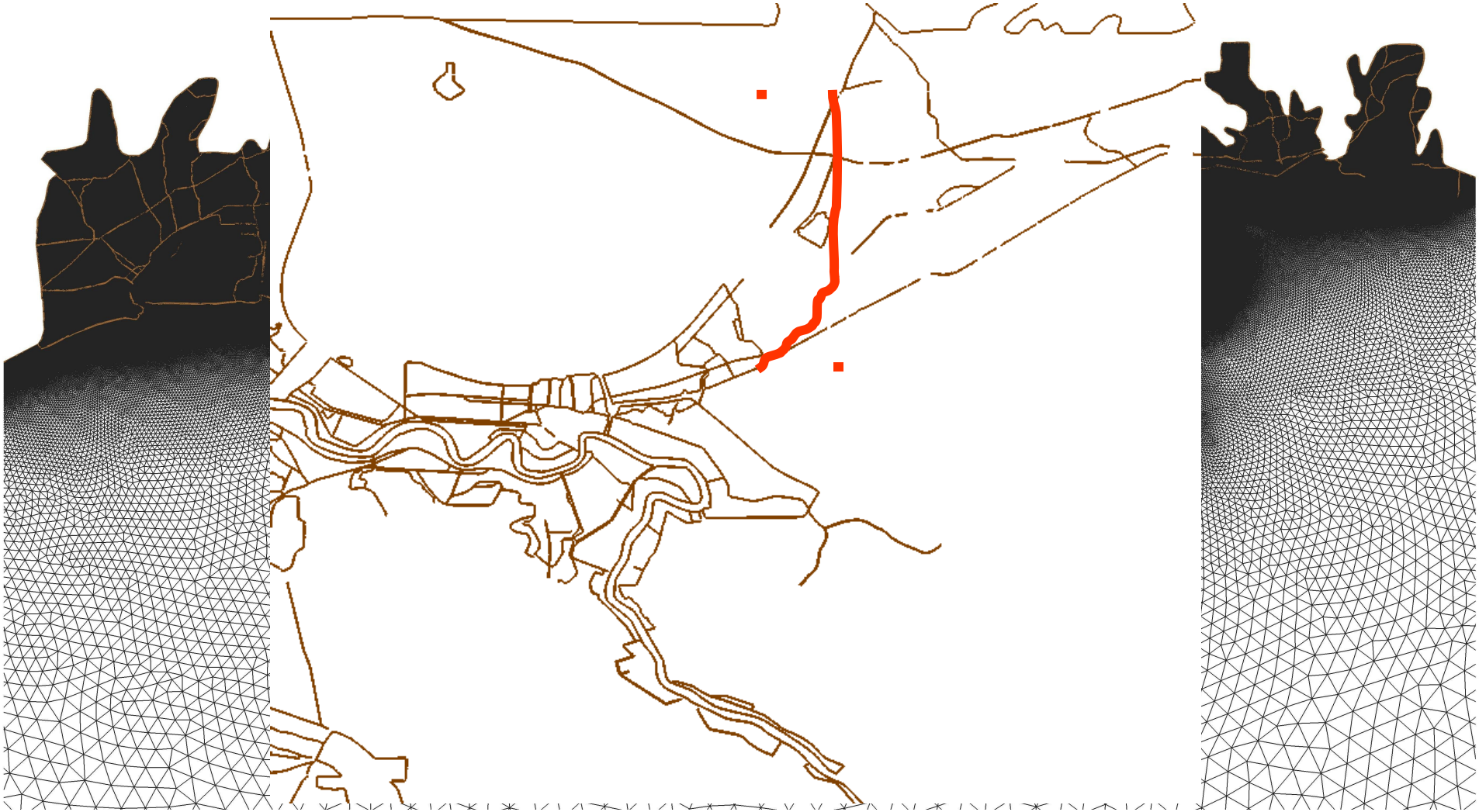
25.000001 - 35.000000
Natchitoches
Grant
La Salle
Catahoula
Concordia
Rapides
Avoyelles
West Feliciana
East Feliciana
St. Helena
Washington
Evangeline
Allen
St. Landry
Pointe Coupee
Tangipahoa
East Baton Rouge
West Baton Rouge
Livingston
St. Tammany
Acadia
Jefferson Davis
St. Martin
Iberville
Ascension
Lafayette
St. John the Baptist
Orleans
St. James
St. Bernard
Assumption
St. Charles
Cameron
Vermilion
St. Martin
Jefferson
St. Mary
Lafourche
Iberia
Plaquemines
Terrebonne
100 Yr SWL – NAVD88 2004.65 Feet

Structural Alternatives



Alternatives

- Existing Conditions: LaCPR = MsCIP
- LaCPR Alternatives → MsCIP Existing
- MsCIP Alternatives → LaCPR Existing

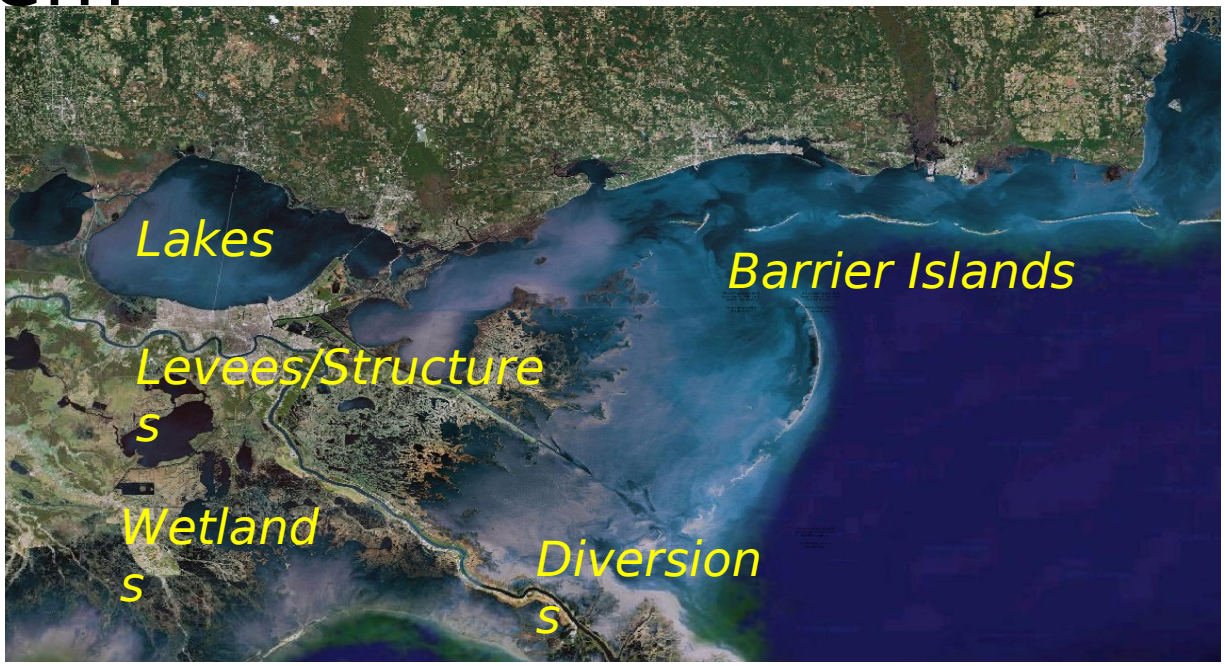
↓

- A combination of preferred alternatives across the region can be modeled together.

System Analysis

Regional Perspective

Engineered System ⟷ Natural System



Storm Surge and Wetlands

- Complicated Dynamics preclude application of simple “rules of thumb” (i.e. X miles of marsh reduces surge by Y feet)
  - Storm track
  - Storm intensity
  - Surrounding topography/bathymetry
  - Vegetation type

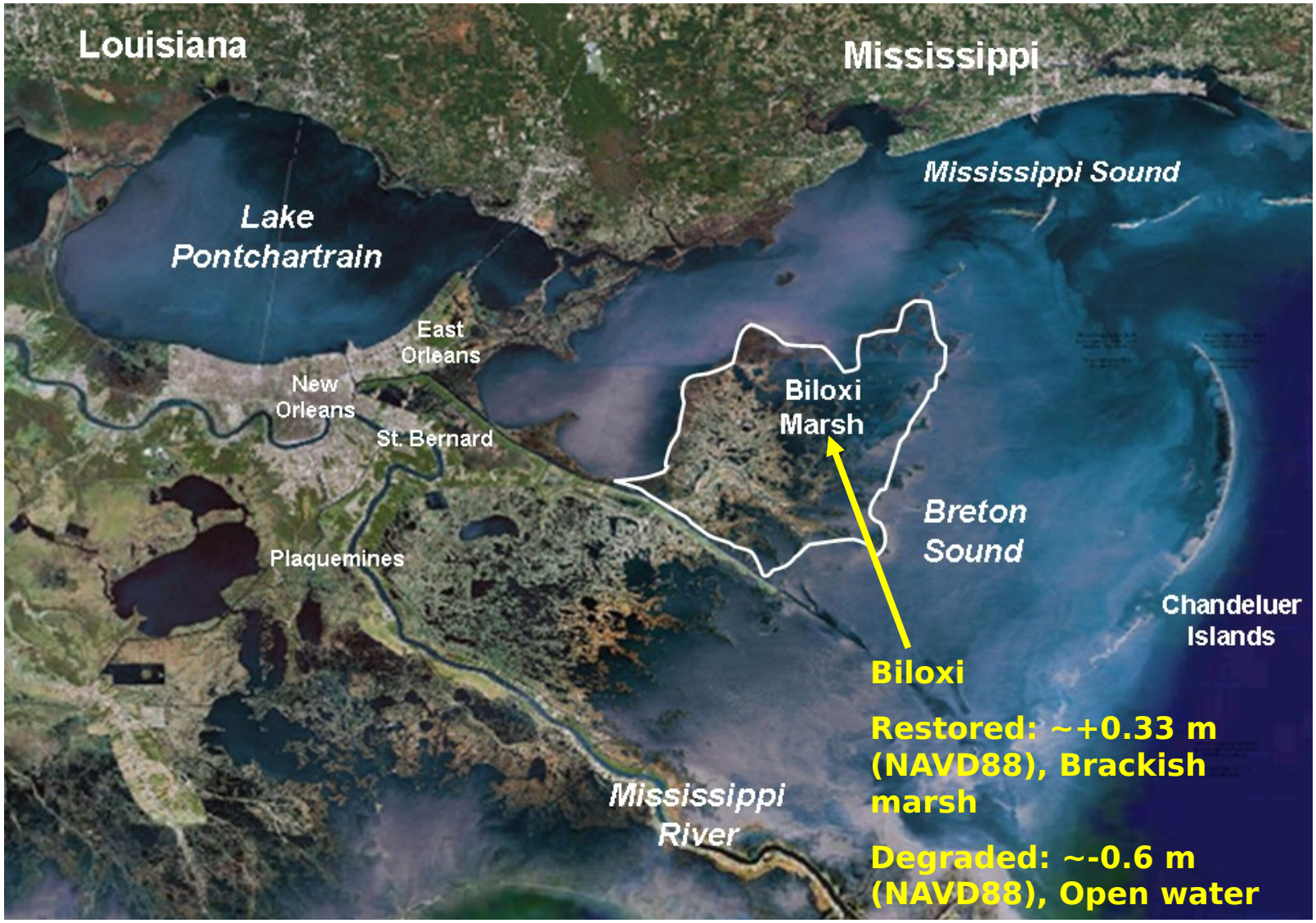
- Modeling is a tool for qualitative and/or semi-quantitative evaluation of the surge reduction potential of coastal restoration features.

Storm Surge and Wetlands

Why the limitations?

- New application of the model and area of active research.
  - Complicated physics
  - Representation of physical system
  - Friction factors
- Very limited data.
  - Need to fund research for field and laboratory studies

Wetland Restoration/Degradation



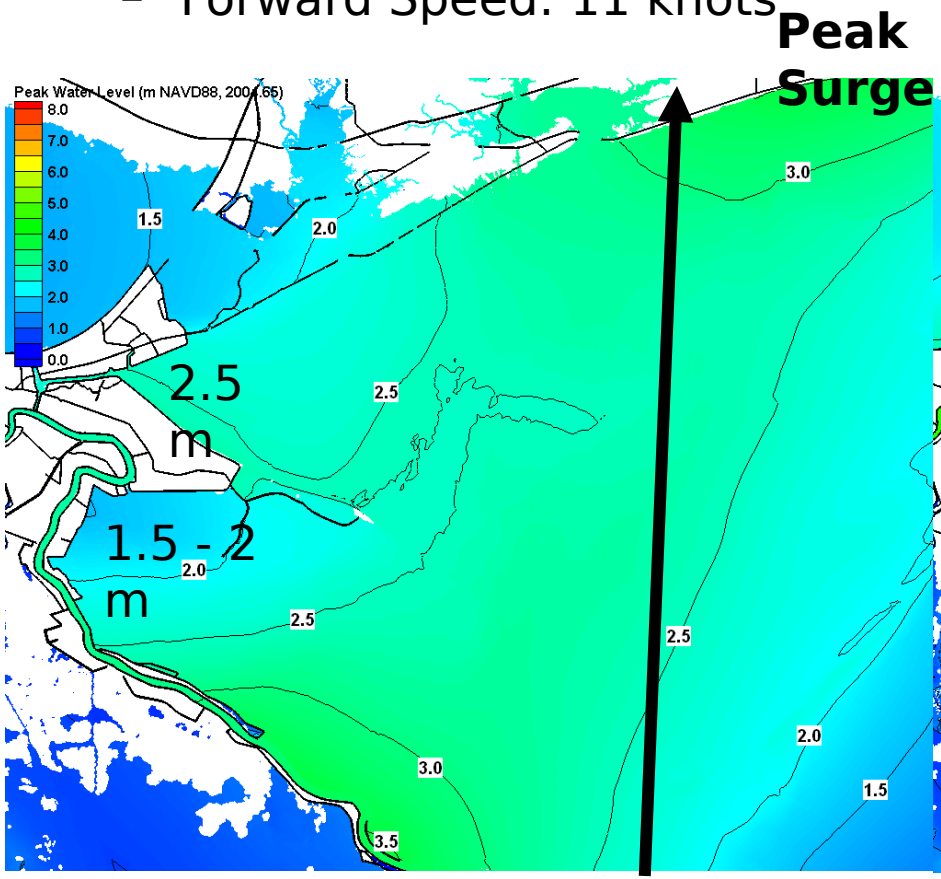
Sensitivity Storms

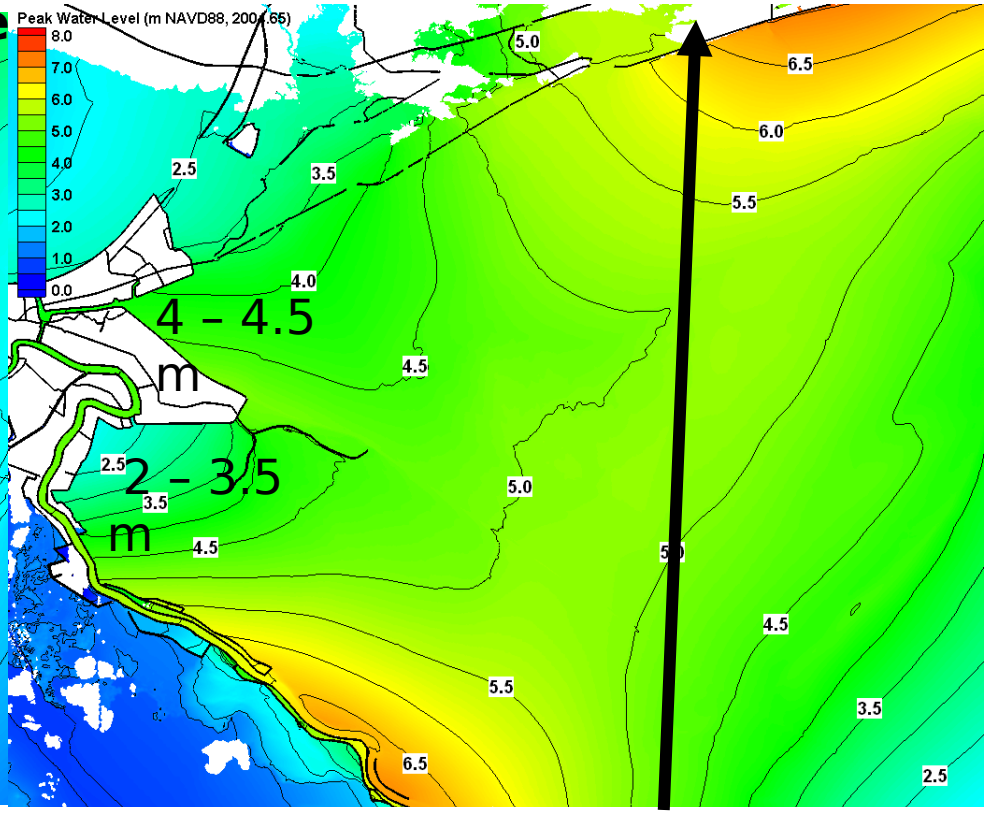
HUR1 (Hurricane Hilda-like)

- Central Pressure: 960 mb
- Rmax: 22 nm
- Forward Speed: 11 knots

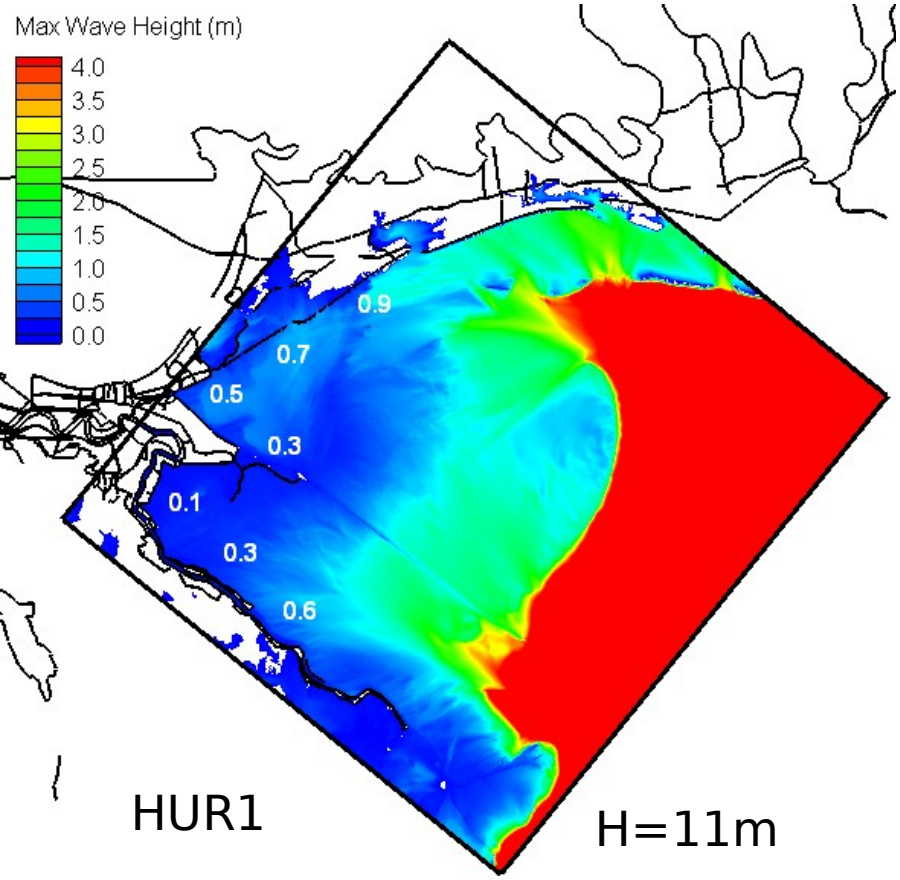
HUR2 (Hurricane Katrina-like)

- **Central Pressure: 900 mb**
- **Rmax: 22 nm**
- **Forward Speed: 11 knots**



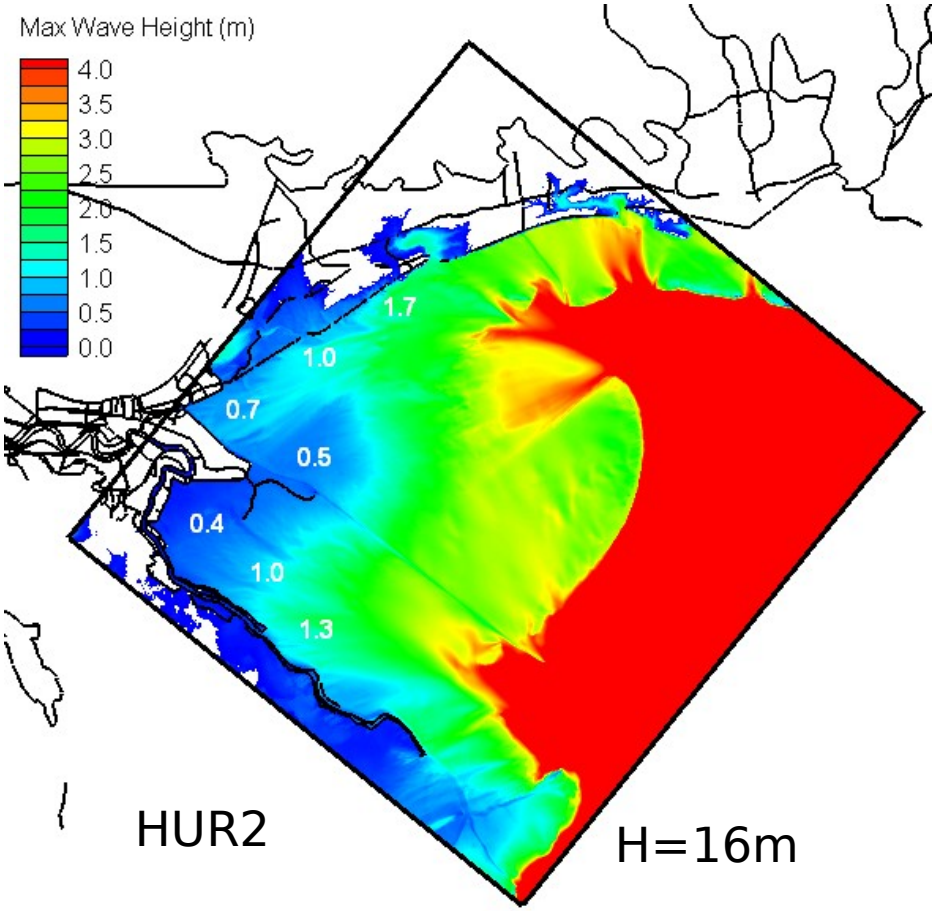


Max Wave Height



HUR1

H=11m

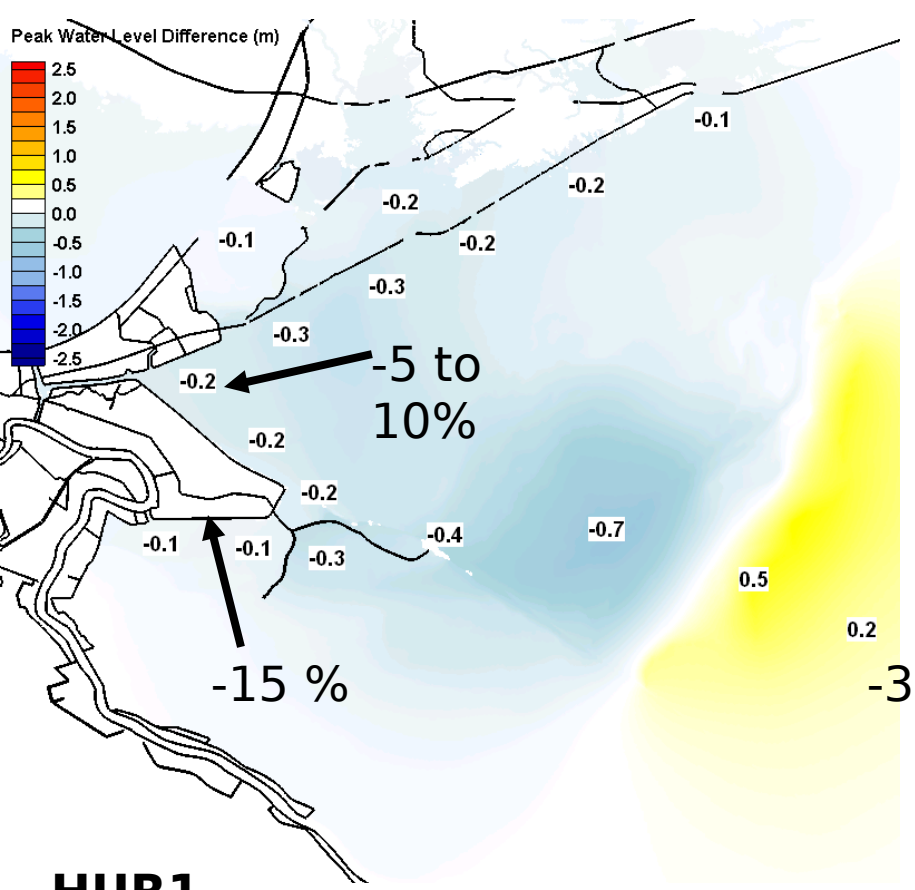


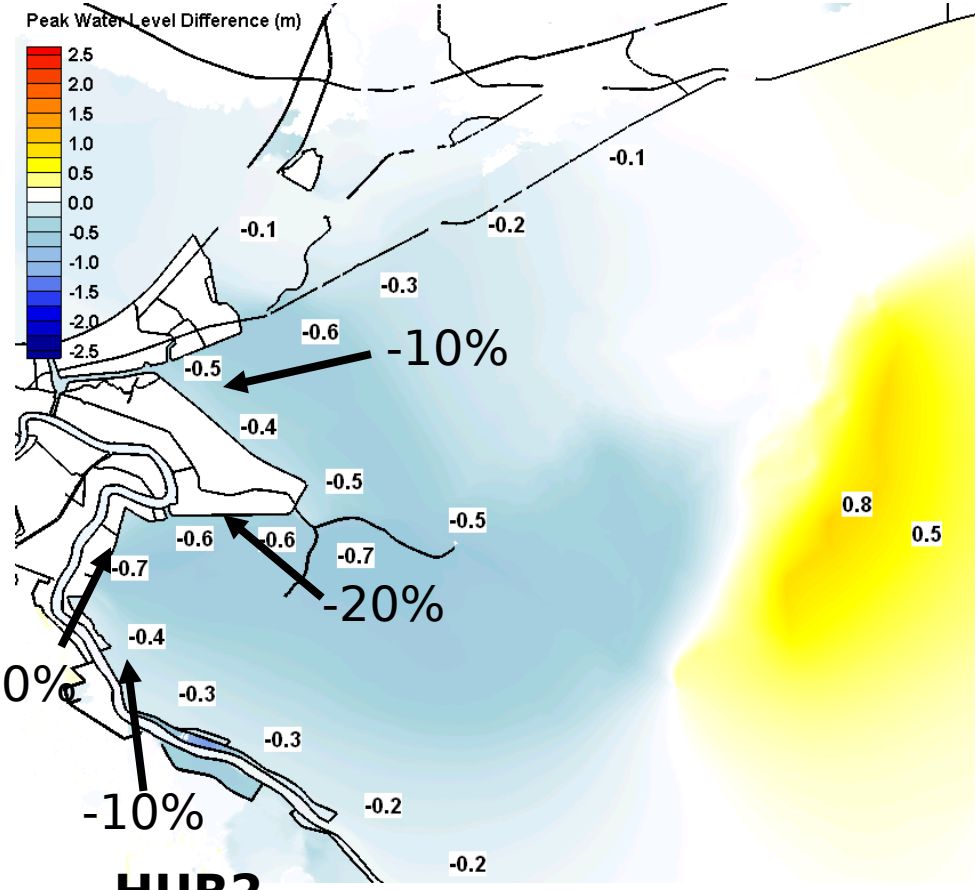
HUR2

H=16m

Biloxi Restoration

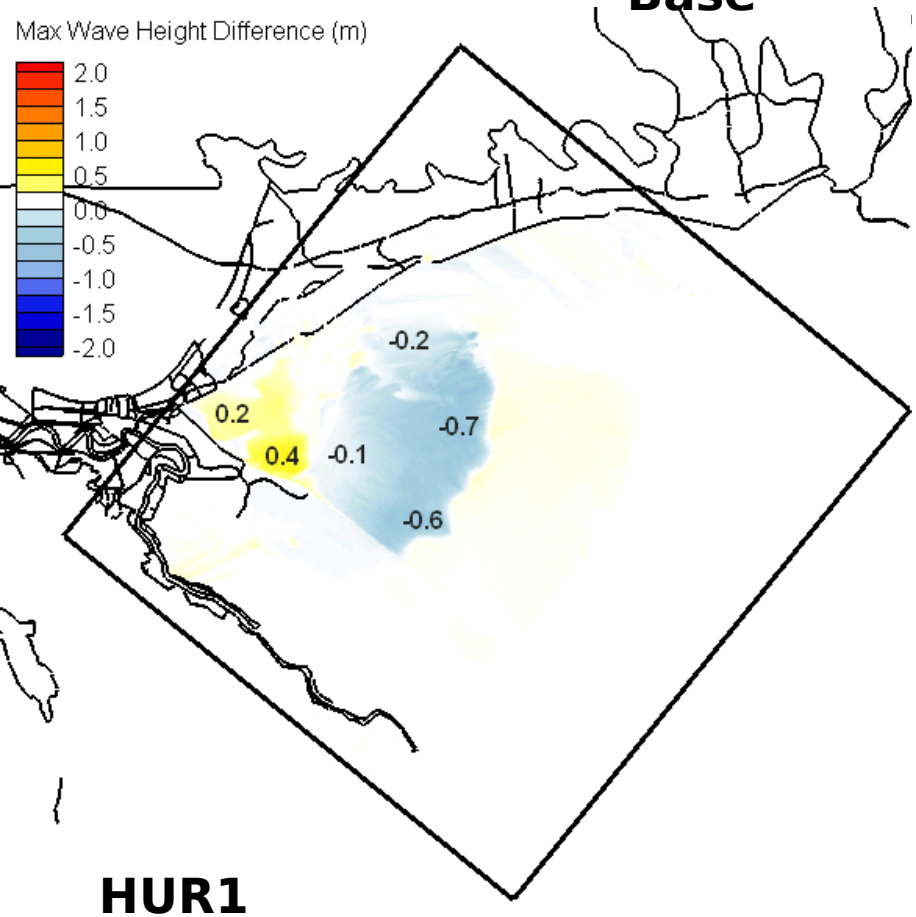
Surge: Restored - Base



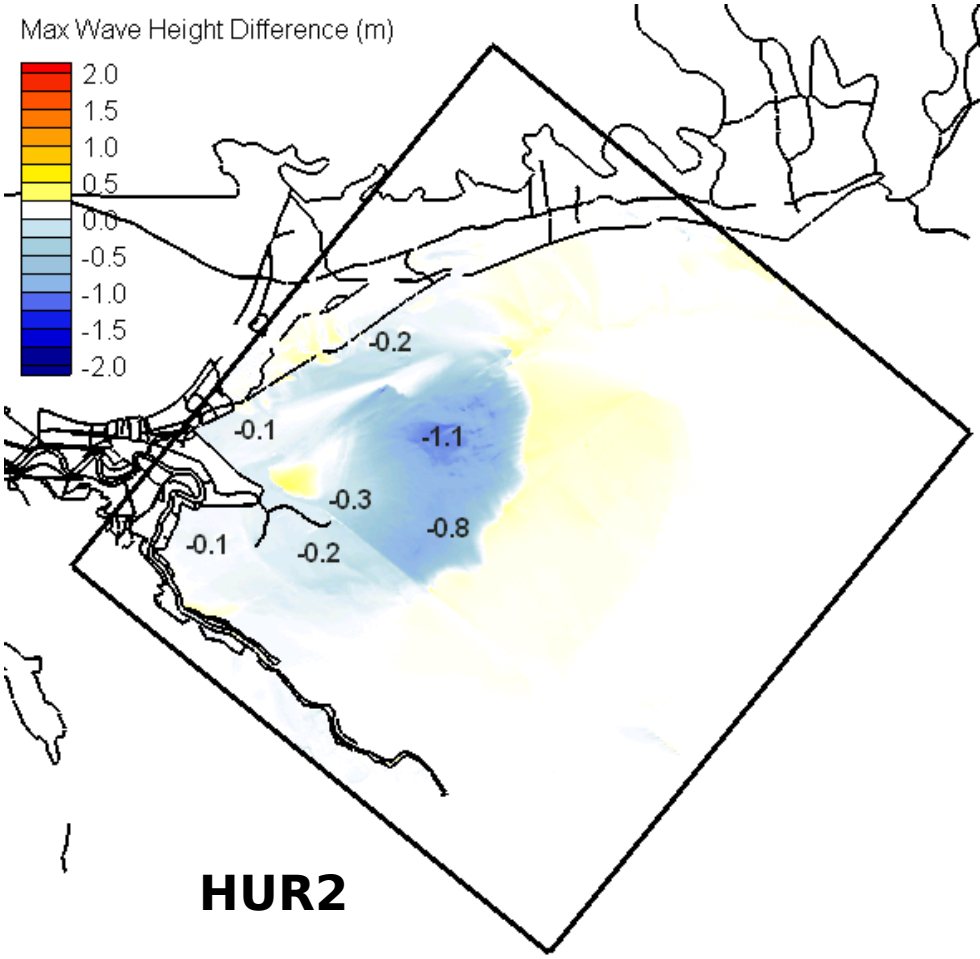


Biloxi Restoration

Waves: Restored - Base



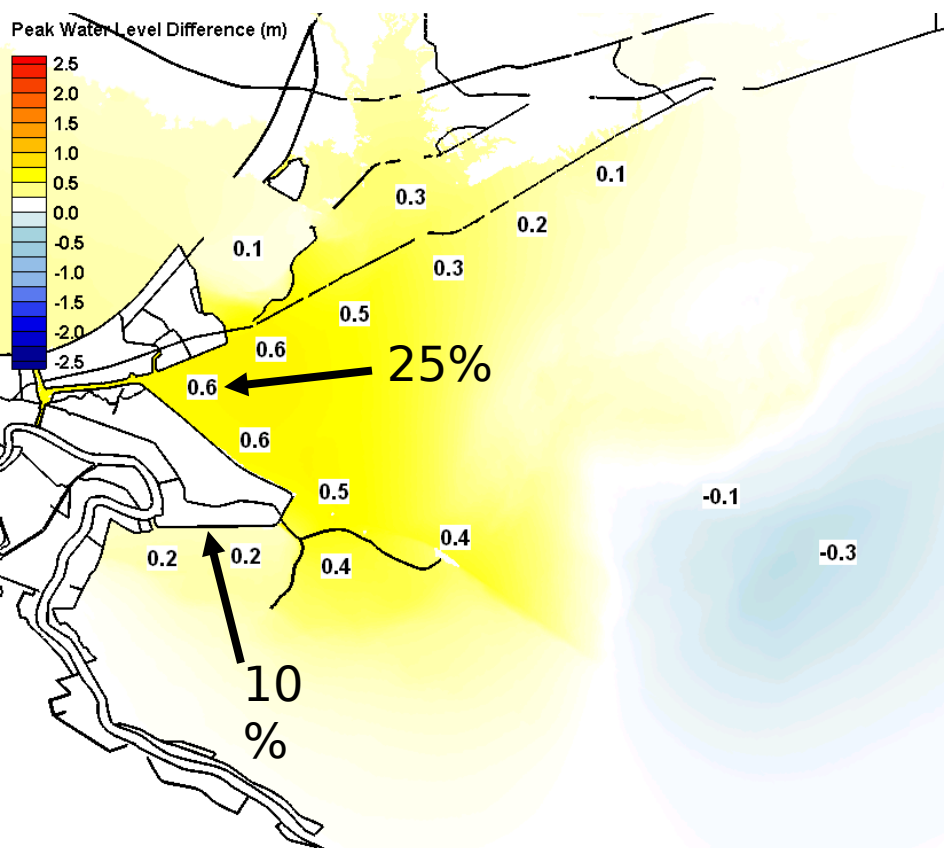
HUR1



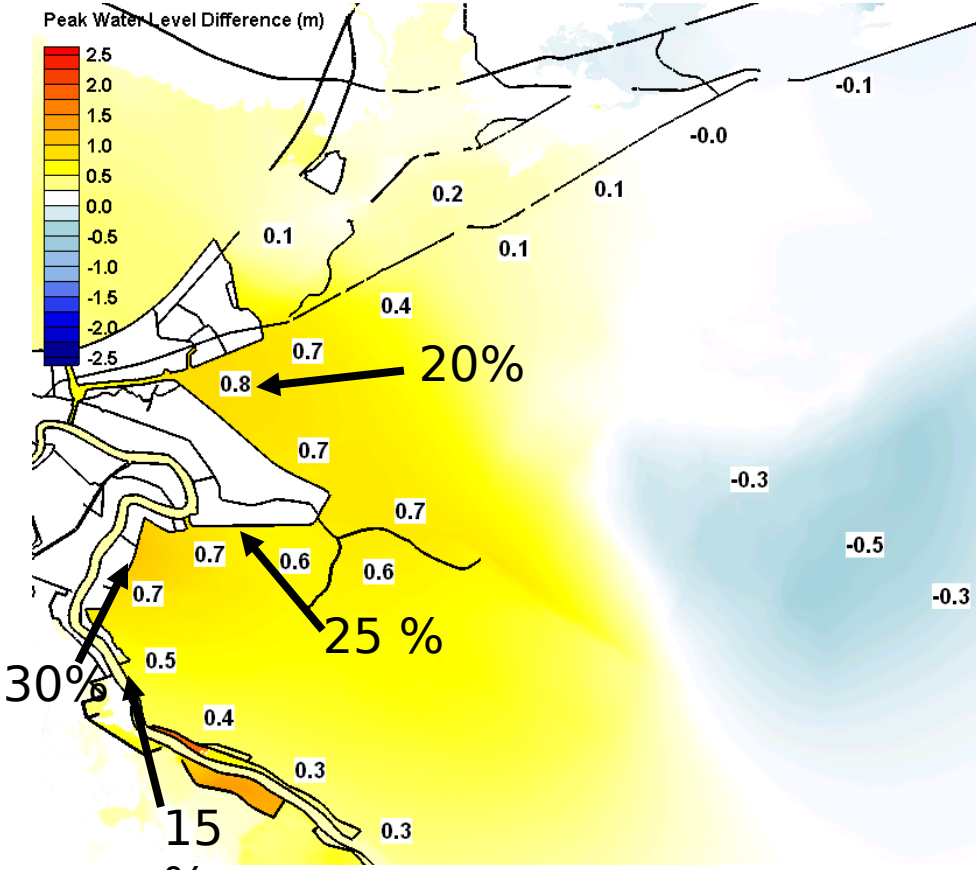
HUR2

Biloxi Degradation

Surge: Degraded - Base



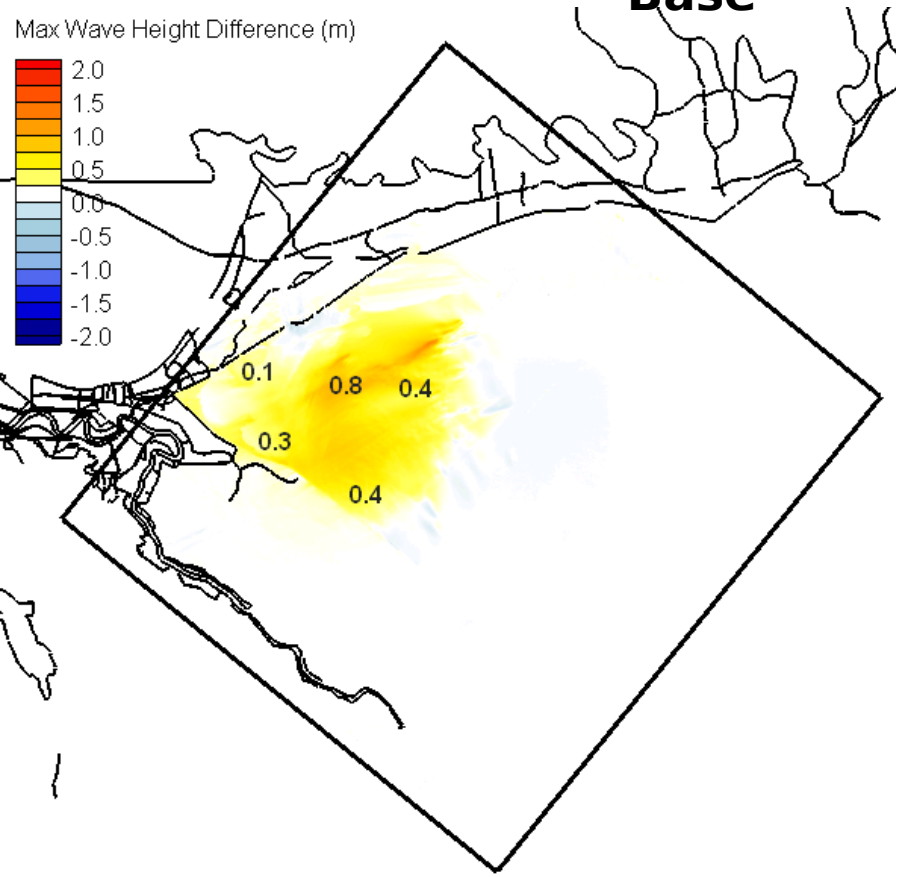
HUR1



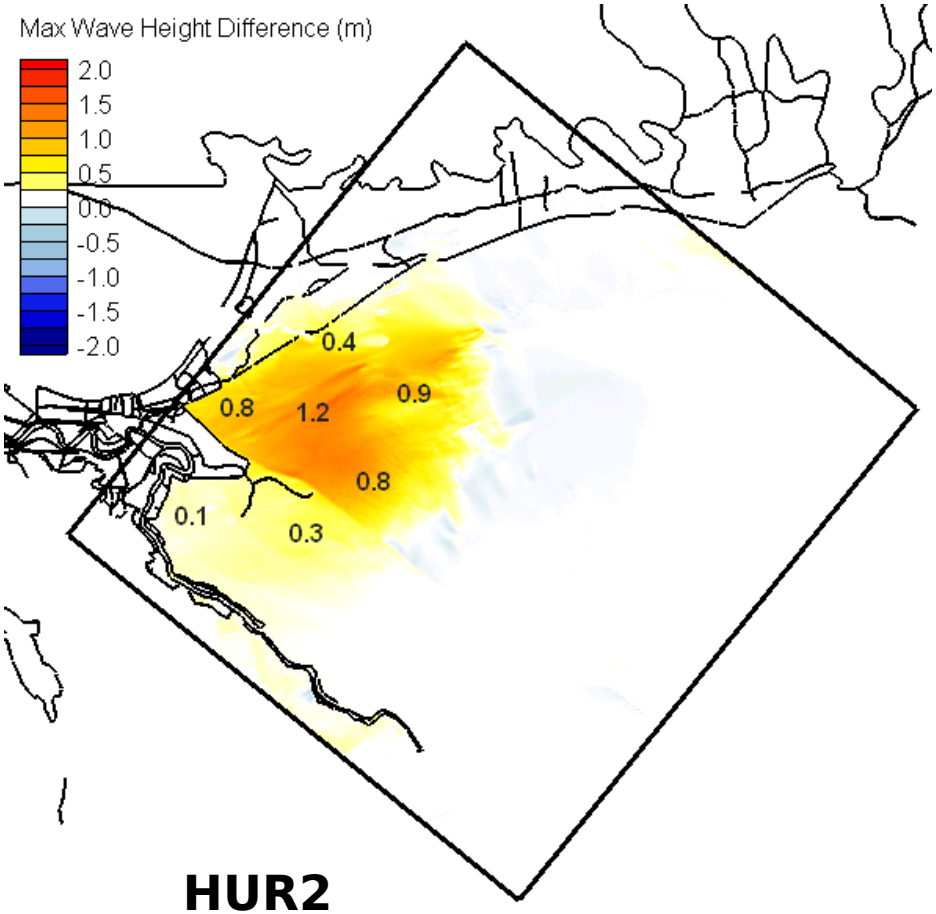
HUR2

Biloxi Degradation

Waves: Degraded - Base

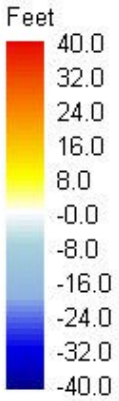


HUR1



HUR2

Barrier Island Sensitivity Analysis



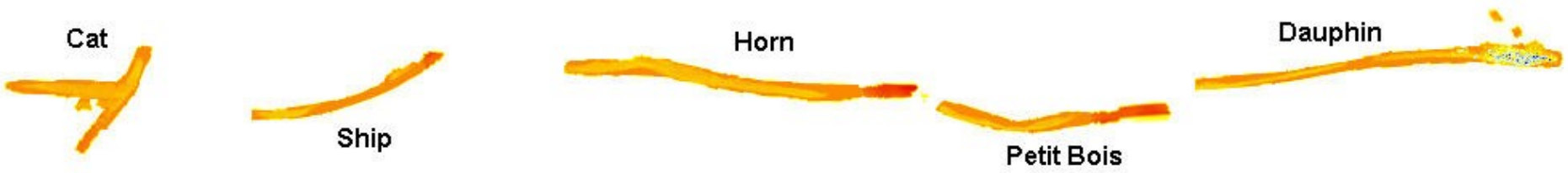
Pre-Camille footprint

+20 ft elevation NAVD88

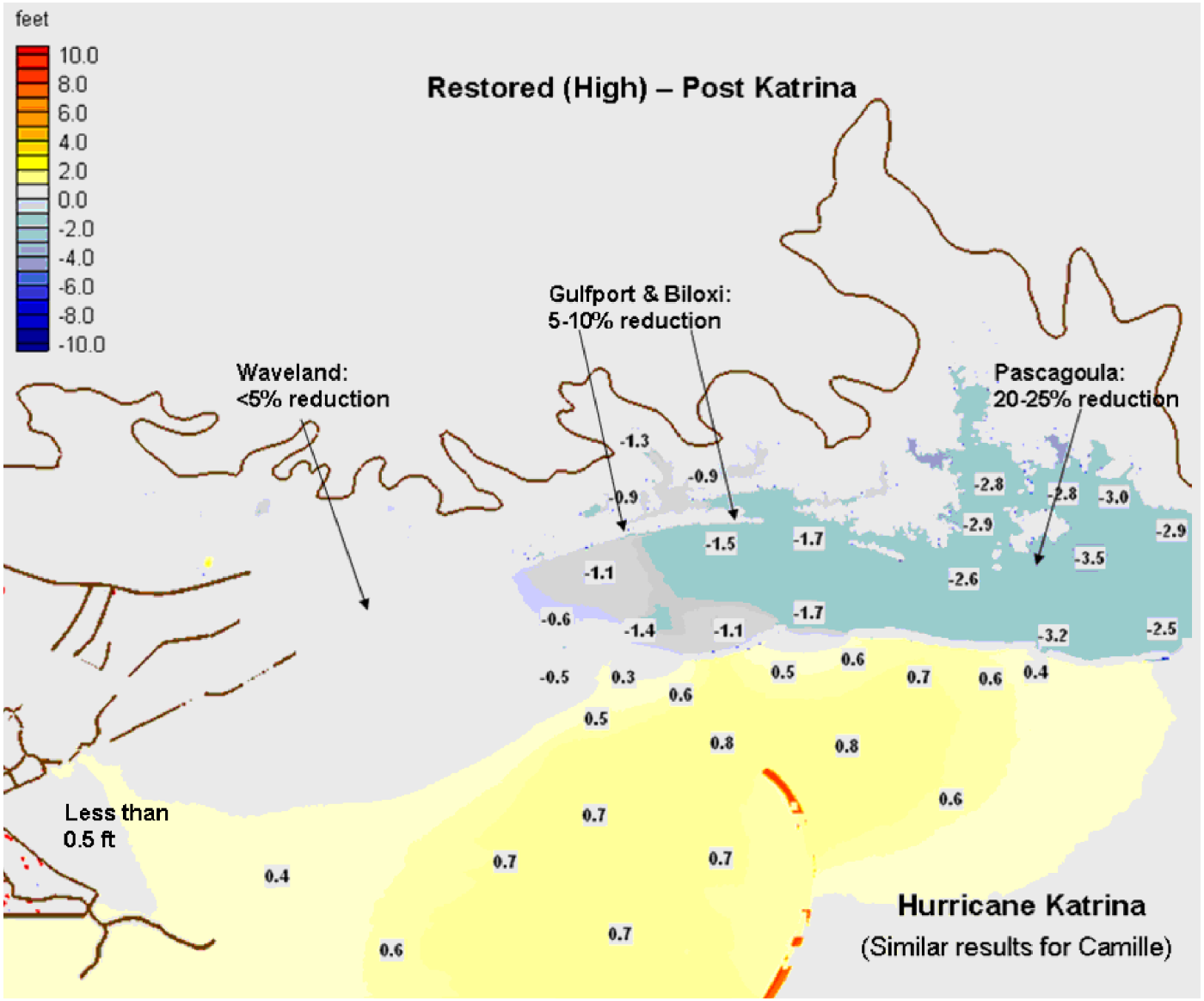
Assumes no morphologic change

Bathymetric Change

Raised - Post-Katrina Barrier Islands



Barrier Island Sensitivity Analysis



Advances

- Multi-process, multi-scale coupling that computes the interaction of tides, riverine flow, wind, atmospheric pressure, and wave radiation stress driven flow to determine water levels.
- Large domains that do not require ad-hoc boundary condition adjustments.
- Unprecedented system definition and grid resolution.
- No ad-hoc localized tuning

R&D Needs

- More data!
  - Field data on surge and wave reduction by vegetated natural features
  - Laboratory studies on wave and water level attenuation by vegetation
- Improved flow resistance formulations
- Assess importance of three-dimensional effects
- Integrate capability to simulate barrier island/levee degradation and breaching
- Integrate localized rainfall-runoff models
- Improve interfaces for sub-grid scale features such as levees

End